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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/786,806	02/25/2004	Kunliang Zhang	HTIRC02-021	3340

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EXAMINER

BERNATZ, KEVIN M

ART UNIT	PAPER NUMBER
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1773

DATE MAILED: 11/15/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

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Office Action Summary

Application No.

10/786,806

Applicant(s)

ZHANG ET AL.

Examiner

Kevin M. Bernatz

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on ____.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-24 is/are pending in the application.
- 4a) Of the above claim(s) ____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) ____ is/are allowed.
- 6) ☒ Claim(s) 1-8 and 13-20 is/are rejected.
- 7) ☒ Claim(s) 9-12 and 21-24 is/are objected to.
- 8) ☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 25 February 2004 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. ____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. ____ |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| Paper No(s)/Mail Date <u>5/6/04</u> . | 6) <input type="checkbox"/> Other: ____ |

DETAILED ACTION

Examiner's Comments

1. The numbering of the claims is not correct, since the claims must be numbered consecutively beginning with the number one. In the instant case, there are two claims listed as number four, the first claim listed being considered "4a" and the second claim being considered as "4b".

Misnumbered claims 4b - 23 been renumbered as claims 5 – 24. The Examiner notes that the dependency of claims 9 – 24 are now incorrect, but for the purposes of evaluating the prior art, the Examiner has interpreted the dependency of these claims to all be one higher, e.g. claim 24 depends from claim 8, not claim 7. Applicants are requested to correct the claim numbers + dependencies when submitting a response to this office action.

2. Regarding the limitation(s) "having improved GMR and magnetorestriction qualities" in claim 1 and "having improved GMR qualities" in claim 13, the Examiner has given the term(s) the broadest reasonable interpretation(s) consistent with the written description in applicants' specification as it would be interpreted by one of ordinary skill in the art. *In re Morris*, 127 F.3d 1048, 1054-55, 44 USPQ2d 1023, 1027 (Fed. Cir. 1997); *In re Donaldson Co., Inc.*, 16 F.3d 1190, 1192-95, 29 USPQ2d 1845, 1848-50 (Fed. Cir. 1994). See MPEP 2111. Specifically, the Examiner notes that these preamble limitations are relative terms in that they don't define what the base level of the GMR and magnetorestriction qualities are – i.e. improved versus what value? As

such, the Examiner has interpreted these limitations as simply requiring that the GMR and magnetorestriction qualities be values which would be accepted as suitable for conventional magnetic heads.

Claim Objections

3. Claim 24 objected to under 37 CFR 1.75 as being a substantial duplicate of claim 12. When two claims in an application are duplicates or else are so close in content that they both cover the same thing, despite a slight difference in wording, it is proper after allowing one claim to object to the other as being a substantial duplicate of the allowed claim. See MPEP § 706.03(k).
4. Claims 9 – 12 and 21 – 24 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Claim Rejections - 35 USC § 112

5. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.
6. Claims 1, 2, 13 and 14 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

The term "ultra-thin" in claims 1 and 13 is a relative term which renders the claims indefinite. The term "ultra-thin" is not defined by the claim, the specification does

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not provide a standard for ascertaining the requisite degree, and one of ordinary skill in the art would not be reasonably apprised of the scope of the invention. For the purposes of evaluating the prior art, the Examiner has interpreted any layer suitable for use as free layer of a magnetic head as meeting the limitation of "ultra-thin".

The term "iron rich" in claims 2 and 14 is a relative term which renders the claims indefinite. The Examiner notes that the term "iron rich" is typically taken to mean that the alloy must be the primary component in the alloy, i.e. in a $\text{Co}_x\text{Fe}_{1-x}$ alloy, Fe would be required to be $>50\%$ (or $x < 0.5$). However, this does not appear to be the intent of applicants, given that they define a suitable x as in the range of $0.25 - 0.75$. As such, the Examiner suggests deleting the term "rich" from claims 2 and 14 since there is confusion as to whether applicants intend to limit x to <0.5 or whether the range of $0.25 - 0.75$ is the correct range. For purposes of evaluating the prior art, the Examiner has taken x to be the range $0.25 - 0.75$.

Claim Rejections - 35 USC § 103

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

8. Claims 1 and 13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Gill (U.S. Patent No. 6,127,045) in view of Smith et al. (U.S. Patent App. No. 2002/0085323 A1).

Regarding claim 1, Gill discloses a CPP TMR sensor comprising a substrate (*Figure 4, element 450*), a seed layer formed on the substrate (*element 440*), an antiferromagnetic (AFM) pinning layer formed on the seed layer (*element 430*), a synthetic AFM pinned layer meeting applicants' claimed structural limitations formed on the pinning layer (*elements 422, 424 and 426*), a laminated free layer formed on layer AP1 of the pinned layer (*element 410*), the free layer including at least one lamina of a first ferromagnetic (FM) material having a positive coefficient of magnetostriction ($+\lambda_s$) (*element 414 and relevant disclosure thereto*) and at least one layer of a second FM material having a $-\lambda_s$ (*element 416 and relevant disclosure thereto*), and a capping layer formed on said free layer (*element 405*).

Gill fails to disclose a GMR sensor meeting applicants' claimed limitations.

However, the Examiner notes that it is well known in the art that the only difference between a TMR and GMR sensor is the selection of material for the spacer layer between the free and pinned layers (i.e. a GMR uses a metallic conductive layer and a TMR uses an insulating layer), as taught by Smith et al. (*Paragraphs 0001 – 0007*).

It would therefore have been obvious to one of ordinary skill in the art at the time of the applicant's invention to modify the device of Gill to be a CPP-GMR sensor instead of a CPP-TMR sensor as taught by Smith et al., since both sensors are functional equivalents and merely require the substitution of the spacer layer from an insulating material to a conductive material. Such a substitution is deemed to be clearly within the knowledge of one of ordinary skill in the art.

Regarding claim 13, Gill discloses that the lamina of the free magnetic layer directly effect the magnitude and positive or negative value of λ_s (*col. 6, line 31 bridging col. 7, line 42*).

9. Claims 2 – 4 and 14 – 16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Gill ('045) in view of Smith et al. as applied above, and further in view of Gill (U.S. Patent No. 6,674,617 B2).

Gill ('045) and Smith et al. are relied upon as described above.

Regarding claims 2 and 3, neither of the above disclose the specific alloys and materials meeting applicants' claimed limitations, though Gill ("045) does teach using Co30Fe70 for the first ferromagnetic alloy (*col. 7, lines 32 – 42*).

However, Gill ('617 B2) teach that the alloy choice and thickness of the layers can be varied to effect the magnetostriction of the individual layers and the overall magnetostriction of the laminate (*col. 3, line 24 bridging col. 4, line 27*). Therefore, the Examiner deems that it would have been obvious to one having ordinary skill in the art to determine the choice of alloys and thickness values of the first and second materials, especially given the teaching of using CoFe alloys meeting applicants' claimed composition for the first ferromagnetic material by optimizing these results effective variables through routine experimentation, given the teaching that these values can be optimized to control the magnetostriction of the layers. *In re Boesch*, 205 USPQ 215 (CCPA 1980); *In re Geisler*, 116 F. 3d 1465, 43 USPQ2d 1362, 1365 (Fed. Cir. 1997); *In re Aller*, 220 F.2d, 454, 456, 105 USPQ 233, 235 (CCPA 1955).

The Examiner further notes that 5 angstroms is deemed to read on the language "less than approximately 3 angstroms", though the Examiner also notes that this is simply the preferred range disclosed in Gill ('617 B2) and does not preclude lower values from the optimization process.

Regarding claim 4, the Examiner notes that Gill ('045) teach forming the synthetic pinned layer out of a $+\lambda_s$ and a $-\lambda_s$ material layer and the thickness of the layers would be optimizable for the same reasons are noted above for claims 2 and 3.

10. Claims 5 – 8 and 17 – 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Gill ('045) in view of Smith et al. as applied above, and further in view of Gill (U.S. Patent No. 6,870,716 B2) and the admitted prior art of Li et al. (U.S. Patent App. No. 2004/0179311 A1). While the Examiner notes that Li et al. is commonly assigned to the present application, the teachings in Li et al. are only relied upon to show the level of ordinary skill in the art at or around the time the invention was made (*Ex parte Erlich*, 22 USPQ 1463 (Bd. Pat. App. & Inter. 1992) (MPEP 2124).

Gill ('045) and Smith et al. are relied upon as described above.

Neither of the above disclose forming a Cu spacer layer meeting applicants' claimed limitations.

However, Gill ('716 B2) teach forming a Cu spacer layer between a $+\lambda_s$ and a $-\lambda_s$ FM layer in order to control the coupling to be antiparallel and to optimize the magnetostriction (*col. 6, lines 6 – 63*). The Examiner notes that this meets the structural limitations in claims 5 – 8 and 17 – 20 since "formed on" and "formed thereupon" does

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not further limit the structure since one can simply turn the sensor upside down and the layer goes from being "formed on" to being "formed thereupon". While Gill ('716 B2) does not teach a thickness, the Examiner notes that one of ordinary skill in the art would have possessed the knowledge that CoFe layers with a very thin laminate of copper can lead to improved CPP-GMR performance and high $-\lambda_s$, as admitted by Li et al.

(Paragraph 0006). Therefore, the Examiner deems that it would have been obvious to one having ordinary skill in the art to optimize a thickness of the copper layer to meet applicants' claimed limitations by optimizing the results effective variable through routine experimentation, given the knowledge in the prior art that very thin copper layers laminated with CoFe layers can lead to improved CPP-GMR performance and high $-\lambda_s$.

Allowable Subject Matter

11. The following is a statement of reasons for the indication of allowable subject matter: the prior art of record fails to teach or render obvious a free layer meeting the structure recited in claims 9 and 21.

Conclusion

12. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Horng et al. (U.S. Patent App. No. 2004/0252418 A1) teach a substantially identical GMR where the magnetostriction of the free layer is controlled. However, Horng et al. fail to teach or render obvious a free layer comprising both a negative and positive magnetostriction layer. Hasegawa et al. (U.S. Patent No.

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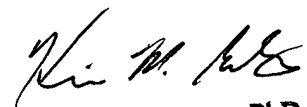
5,891,586) disclose magnetostriction values (positive or negative) for the composition range of a CoFeNi alloy (*Figure 3*).

13. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Kevin M. Bernatz whose telephone number is (571) 272-1505. The examiner can normally be reached on M-F, 9:00 AM - 6:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carol Chaney can be reached on (571) 272-1284. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

KMB
November 10, 2005


Kevin M. Bernatz, PhD
Primary Examiner